Homoepitaxial growth rate analysis for InP / InP (doped)

To complement its unique range of in-situ sensors, LayTec offers EpiTT 950 for InP based growth and many other applications. This sensor performs highly accurate reflectance measurements and true wafer temperature measurements by emissivity corrected pyrometry. EpiTT is ideally suited for growth rate analysis and temperature control in production type MOCVD and MBE systems. With its second reflectance measurement wavelength, at 950 nm EpiTT monitors growth rate and wafer temperature at the ideal wavelength of the growing material, one broadband and one with a narrow band width, thus enhancing the precision of measurement!

LayTec's customer Dr. A.J. SpringThorpe from the National Research Council of Canada was very kind to provide us with the data showing clear Fabry-Perot Oscillations (FPO) during growth of a 500nm undoped InP buffer layer on a Sulphur ($2 \cdot 10^{18}$/cm³) doped substrate (Fig. 1).

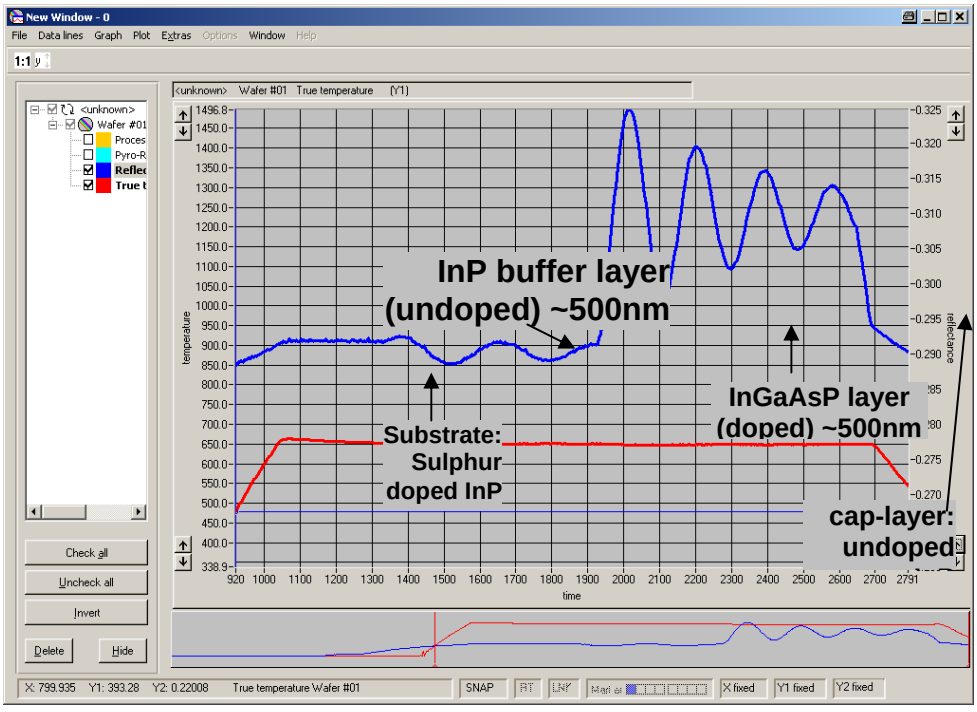

Fig.1:

True temperature (red curve) and reflectance data (blue) of an undoped buffer layer on sulphur doped substrate ($2 \cdot 10^{18}$/cm³) overgrown with 500nm doped InGaAsP and covered with 20nm undoped InP cap layer. The FPOs of the InP buffer layer on top of the InP substrate (homoepitaxy) are clearly visible

For this application an **EpiTT** sensor was used measuring simultaneously two growth parameters:

- the accurate wafer temperature via emissivity corrected pyrometry
- the accurate growth rate of the growing material, even for thick layers, due to its double-wavelength concept. All growth rate information given in this InP-related application comes from measurements at 950nm ±5nm.

LayTec AG
Seesener Str. 10–13
10709 Berlin
Germany
Tel.: +49 (0)30·39 800 80-0
Fax: +49 (0)30·39 800 80-80
info@laytec.de
www.laytec.de

The screenshot in Fig. 1 shows the temperature and the reflectance data of the complete run. Even in the case of growing an undoped InP buffer layer on the doped InP substrate, FPO can be seen clearly. This buffer layer growth can be used to calculate the growth rate with LayTec's Growth-rate-calculation Module (Fig. 2)

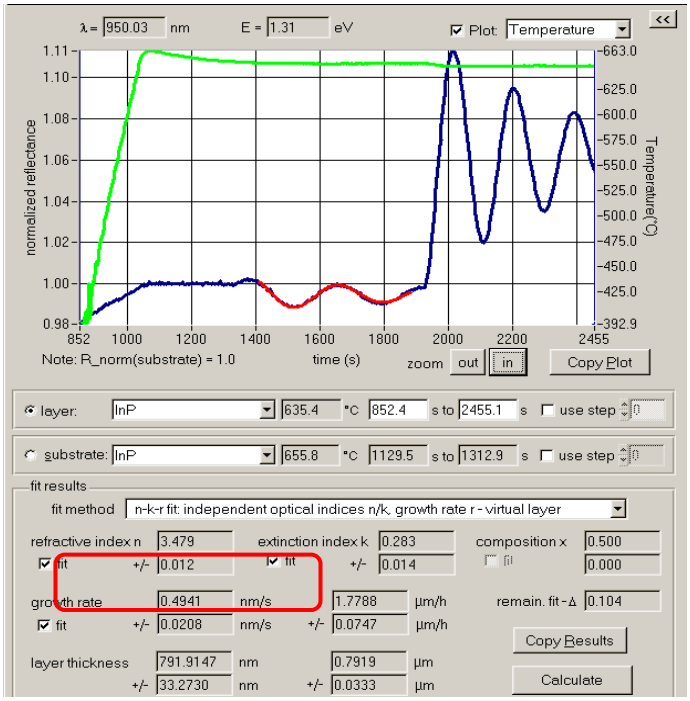

Fig. 2:

Real-time reflectance and wafer temperature during growth of InP (1400 s to 1950 s) and InGaAsP (>1950 s) on highly doped InP substrate.
The red curve is the result of LayTec's virtual layer approach calculation for determining the growth rate for this layer.

The respectively calculated InP growth rate of 0.494 nm/sec (Fig.2) fits perfectly to the ex-situ measured growth rate of 0.5 nm/sec. According to Dr. SpringThorpe, it is impressing to see the exact growth rate calculation results of homoepitactic layers. This effect is caused by differences of the refractive index of doped and undoped materials. For the later growth of InGaAsP and the cap layer, the growth rate can be fitted the same way.

EpiTT sensors are available for many MOCVD and MBE growth systems. For further information please contact info@laytec.de